devoted to the consideration of speech, in which the conditions of "word-deafness" and "word-blindness" are now discussed. The view which has been put forward, amongst others, by Dr. Hughlings Jackson, that there are other and higher centres, over and above those which have been demonstrated by physiological and clinical research, which form the substrata of the higher mental operations, does not receive support from Dr. Ferrier. "It seems more reasonable to believe that there may be higher and lower degrees of complexity in the same centres than to assume the separate existence of more highly evolved centres, for which no evidence is obtained by the results of experimental research" (p. 460).

It might have been expected that the remarkable conditions of the cerebral functions which are met with in both man and animals in an hypnotic state would at least have been alluded to in this edition, but they appear to have entirely failed to attract the author's interest, and the subject is passed over in silence.

In conclusion it may confidently be affirmed that, whatever exception may be taken to this or that statement or opinion, or to the mode in which this or that question is discussed, this new edition of Dr. Ferrier's work, from the care with which it has been revised, the extent of the information which it contains, and the clearness of style and lack of ambiguity which characterise its every page, must prove of the greatest value to the student of neurology, and cannot fail to enhance the high reputation of its author. E. A. SCHÄFER

THE VALUE OF THE NEW APOCHROMATIC LENSES

AT the annual meeting of the Royal Microscopical Society, the Rev. Dr. Dallinger, who was elected President for a fourth year, delivered his annual address, in the course of which he gave a judgment concerning the new object-glasses made with the new German glass, in the following terms:—

In proceeding to fulfil the honourable duty that, by your courtesy, devolves upon me, I purpose in the main to follow the line I have taken in preceding years. I congratulate the Society on its work, and on its steady influence in promoting progressive improvements in the optical and mechanical construction of the microscope, devoid of all prejudice as to how, or from whence, such improvements may come. And whilst, happily, it is not of necessity a President's duty to pass in cursory review the microscopical work of the year, there are times when it may be well for him to review the points of improvement that have been made in the instrument itself.

For the past twenty years I have had an increasing interest in the continuous improvement of the optical appliances of our instrument—an interest which, from the first, applied not only to objectives, but also to eye-pieces and condensers, which consecutive calculation, thought, and experience have shown to have a correlated importance.

Eighteen years ago I had, by practice, made myself fairly master of a 1/25-inch objective of that period made by Powell and Lealand. I still possess that lens, and it is as good a lens of its class as they ever constructed. Soon after, I became equally familiar with a 1/50-inch of the same class by the same makers.

By saying that I became master of these lenses, I mean that I discovered exhaustively what they would and what they would not do. By this, I learned definitely what I wanted in lenses, if I could get it; and to get that has been my unceasing endeavour until now. And certainly the quest has not been vain. And my method has been to examine impartially, and possess myself of, English, Continental, or American lenses, whenever they have shown any capacity for doing best what my work proved to me required to be done.

I know that, in estimating the quality of a lens by the class of image it affords of certain test-objects well known to us, a certain amount of empiricism must take place. We do not absolutely know the image it ought to present. But this only applies within very narrow limits. Take the Podura scale: I can give you an image of it with my 1/25-inch and 1/50-inch of twenty years ago. What I, in common with most microscopists, considered then the *best* result, the most sharp, clear, and delicately defined image, with those lenses I can get now; but, with those lenses, nothing better.

But the elements—the essential features that constituted the quality of beauty in that image—are the very elements, the actual features, that every admitted improvement in our object-glasses has brought out more perfectly. So that if I now put, say, the Podura scale under my old dry 1/25-inch objective, and, beside it, another precisely similar scale under a new homogeneous 1/20-inch objective of N.A. (numerical aperture) 1·5, the very qualities of the image which I, and experienced microscopists generally, thought the best twenty years ago are incomparably transcended in beauty and perfectness now.

But that is not, and has not been, my only or my chief test. It has been one more eminently practical, so far as my own work went; at least for some years.

Up to ten years ago, although I had spent weeks in patient effort, no lens that I possessed, or that was within my reach, could be made to reveal the flagella of *Bacterium termo*. The flagella of many minute monads and of such Bacterial forms as *Spirillum volutans*, and even *Bacterium lineola*, I could demonstrate, though some of them with difficulty; but not a trace of that of *B. termo*. But, near that time, Powell and Lealand produced a battery of immersion-lenses on a new formula and of much relative excellence; and with these lenses the flagella of *B. termo* were brought within the range of sight.

Since that time that has been a good lens, to me, in proportion to the greater or less ease and perfection with which it has revealed this delicate fibre. And let me say that such lenses as do this are those that always, without fail, give us the best ideal image of Podura scales and other tests. You will pardon me, I trust, for this amount of personal reference, since it will give a greater relevancy to what will follow.

Improvements of great optical importance have been made during the last few years. The manufacture of homogeneous lenses by Messrs. Powell and Lealand gave us the opportunity, which we could not have with foreign makers, of urging certain modifications. The addition of the correction collar was a minor, but still important, point. But the great point was the increase of the N.A. These makers have shown themselves most anxious, and have spared no efforts, to reach the highest aperture yet attained.

Advancing, say, from N.A. 1·25, they attained to 1·35 in such powers as the 1/25-inch and the 1/50-inch; subsequently to 1·47 in 1/8- and 1/12-inch objectives; and finding these, from my working point of view, of such supreme gain, I urged them still on, and was ultimately rewarded by the possession of a 1/6-inch N.A. 1·5., followed by a 1/12- and a 1/20-inch foci of the same great aperture. From each of these I obtained special advantages over all like powers, but with lower apertures, within my reach.

A question frequently asked may be asked again, In what way do these last increments of aperture aid us? The practical answer is not difficult. Speaking from observation, I may say that all the objectives I have employed for the most critical work fail to produce images by the extreme marginal zone of the aperture. It is the judgment of competent judges that it will be fair to roughly estimate this defective outermost zone at 10 per cent.; so that, from the total measurement of the aperture by Prof.

Abbe's method, I find that in practice this amount may be deducted as of very little service, in all apertures beyond about 1·3; hence, to be able to utilise fully any given aperture beyond 1·3, it is practically necessary that the measurement by means of Abbe's apertometer should be about 10 per cent. higher.

But a further advantage of great numerical aperture is that, other things being equal, we can utilise with excellent results deeper eye-pieces.

I have long realised the advantage, with finely corrected objectives, of a far larger series of eye-pieces than the catalogues provide. Messrs. Powell and Lealand several years ago made me one or more eye-pieces between each of their deeper eye-pieces of standard catalogued focus, and they certainly, within the limit of excellence beyond which greater eye-piece power cannot be employed, bring out to far greater perfection the qualities of any high-class object-glass.

But we have had announced to us an improvement in the optical arrangement of the microscope, based upon an important and fundamental change in the media employed in the construction of object-glasses and eye-pieces. It will be known that I refer to the system of apochromatic object-glasses and compensating eye-pieces devised by Prof. Abbe, and under his auspices carried out by Messrs. Zeiss, of Jena.

The aim of the construction of these new objectives and eye-pieces has been to provide a higher degree of achromatism than could be reached by the old media; the new kinds of glass produced at the Jena Optical Glass Works, under the superintendence of Dr. Schott and Prof. Abbe, can be so combined in the construction of an object-glass as to achromatise not only the essential portion of the primary spectrum, but also to a great extent the secondary spectrum, leaving only small residuals of the tertiary order still visible under certain test conditions. The final elements of correction are supplied by "compensating" eye-pieces of special construction designed to correct what Dr. Abbe refers to as "the differences in the amplification of the image for the various colours . . . formed by the objective outside the axis, which cannot be corrected by the objective itself."

The first trials of these new optical combinations made in Germany evoked unstinted praise, and those who, like myself, desired nothing so much as real improvement, awaited their arrival in England with eager and even anxious curiosity.

The first that came to this country came to Mr. Frank Crisp, and by his courtesy this lens, an apochromatic of 1/8-inch focus was placed in my hands. I subjected it to comparison, in succession, with my complete set of high powers, including those of N.A. 1·5, and upon tests, and by methods, which I have indicated.

It will be well understood that the high excellence and great aperture of my three latest object-glasses would have given a very elevated standard of comparison, a standard of comparison, so far as I know, never before reached, and the result was that with the potentiality of the system represented by the apochromatic lens I was most powerfully and hopefully impressed. I felt, in fact, that the lens itself was of great merit. But withal, by my standard of test I felt that its merits had been over-estimated.

It is quite true that on some of my delicate test-objects the images shown by the apochromatic lens in combination with the "compensating" eye-pieces appeared to advantage when compared with my lenses combined with the ordinary eye-pieces; but when I tried my own various powers with the same compensating eye-pieces I am constrained to say that no real advantage over my latest lenses could be discovered. My judgment, therefore, was most favourable as to the immense advantage of the eye-pieces and of the possibilities that lay in the entire system rather than in the special apochromatic object-glass taken by itself; and although pressed again and again by the editors of journals to give a public expression of my judgment, I steadily declined, feeling that it was not, and could not at that time, be exhaustive.

Later, an opportunity was courteously afforded me by the makers to examine a complete series of these object-glasses, from 1-inch to 1/8-inch focus, and with eye-pieces fitted for English stands. In the examination of these objectives and their system of eye-pieces I spared no pains to be exhaustive and impartial. I desired to find the evidence of progression in optical excellence, for which I am always in search, and the excellence of the 1-inch greatly impressed me; but I failed to realise my high hopes in the behaviour of the higher powers. The result, however, of a most critical examination was to very greatly strengthen my conviction of the value of the optical system which these lenses represented, and above all of the excellence of the actually new resource provided for us by the compensating eye-pieces.

In what I have here said I must again remind you that the comparison of Zeiss's apochromatic object-glasses was with a group of object-glasses the most carefully made, most excellently corrected, and with the widest numerical apertures, of any object-glasses that had ever passed through my hands, based on the old system of correction. But with this understanding it appears to me a responsibility that I must not evade to state the facts at this crisis in the development of object-glasses. And I do this with the more confidence that, as I have already informed you, Mr. Mayall, wholly independent of me, examined this set of objectives and eye-pieces, and we each recorded separately, in writing, our judgments at the time of examination; and I subsequently found that our resulting judgments were almost identical.

During this time samples of the new optical glass had reached the English opticians, and Messrs. Powell and Lealand in relatively brief time, and on a formula of their own, made an apochromatic 1/12-inch object-glass, and eye pieces, constructed on the plan devised by Abbe By the wise advice of Mr. Mayall this was exhibited at our November meeting. My high opinion of that lens and its compensating system of eye-pieces I at that meeting expressed, and need only add that since I have become the possessor of a second object-glass of precisely similar construction and power made by the firm, I am much strengthened in the opinion I gave.

We all appreciate the splendid services rendered to microscopy by Prof. Abbe, and it was a happy expression of that appreciation that led Mr. Mayall to propose a visit to Jena, with his microscope and such object-glasses as he thought would worthily represent the standpoint we had now reached in England.

I understand that Prof. Abbe greatly desired this, wishing to possess the fullest information as to our methods of testing object-glasses, and to be permitted to examine our best optical work.

I need hardly say that it was a source of great pleasure to me to place at Mr. Mayall's disposal all the lenses and apparatus I possessed that would serve him; for it was in the highest interests of the microscopy of the world that so great a leader in recent progress should see the effects of his teaching and practice as evidenced by our latest object-glasses, and especially by the new apochromatic 1/12th by Powell and Lealand, with its system of compensating eye-pieces.

Mr. Mayall has told us the story of his visit: of his kindly reception; of the earnest and repeated trials of the object-glasses he was able to submit to Prof. Abbe; and of the frank appreciation expressed by Prof. Abbe of the English object-glasses. This comparison will, in my judgment, "make history" for the future of our instrument. It will react here and in Germany. Prof. Abbe's splendid powers are more than ever concentred on the work of touching a higher perfection in object-glasses;

he knows that every improvement initiated in Jena will be watched by keen eyes in England; and he has evidence, which will be as welcome to him as his work is to us, that we are not likely to neglect any point of excellence, provided only we can be made to see it as such. I understand that Dr. Zeiss admits that the formulæ on which his apochromatic objectives are constructed involve far greater technical difficulties than were met with in the older formulæ; and this is evidenced by the great number of separate lenses combined in the construction.

Now it has long been my judgment, and a judgment that has been confirmed by men of large practical experience, that errors of technical execution, when present, are shown at once by deep eye-pieces: with an object of regular structure, whose image fills the field of the eyepiece, the experienced eye readily detects a want of sharpness. I am bound to say that the apochromatics from Jena did not impress me by this test as having accuracy of technical execution equal to the object-glasses with which they were compared.

On the other hand, I find that with the new apochromatic made by Powell and Lealand I can employ advantageously deeper eye-pieces than I had ever used before.

Now there is a less number of separate lenses in the London objective, and whether this superiority is due to the lesser number of lenses or to other causes I may not determine. I refrain from details concerning the comparisons I, amongst others, made of the lower power apochromatic of Zeiss, further than to remark that in my judgment too much has been sacrificed to the object of enabling the observer to employ very thick cover-glasses. This is, no doubt, a convenience; but if, as in Zeiss's 1/4-inch and 1/6-inch, the choice lies between object-glasses that cannot be used for covered and uncovered objects and object-glasses that, with a moderate range of thickness for cover-glass, provide that facility, the latter appear to me from a practical point of view to be the better.

I note with interest that Powell and Lealand have made an achromatic oil-immersion condenser of N. A. 1·4, and will probably be able to increase the aperture to 1·5 in proportion as thinner glass is used to mount objects upon. The mechanical part of this instrument had, when it first reached me, a very neat form, but was difficult of manipulation; and this, involving as it did alteration, has prevented me from really testing its merits. But I have just received it, with a mechanical modification I suggested well carried out, and I have little doubt but I shall realise now its optical excellence. On the whole, then, we may rejoice in the fact that a distinct advance has been made in the optics of the microscope, and the more so from a conviction that there lies considerable potentiality still in the sources from which the amount of progress made has resulted.

ATLANTIC WEATHER CHARTS

THE Meteorological Council has just issued a folio of synchronous weather charts for the North Atlantic Ocean and the adjacent continents, those now published forming the first part of a series which embraces the thirteen months from August 1, 1882, to August 31, 1883. The whole series is to be issued in four parts, Part 1 containing the charts from August 1, 1882, to November 7, 1882. Two charts are given for each day—one shows the barometer, wind, and weather, whilst the other gives the air- and sea-temperature, and weather, the weather being given on both charts for the purpose of easy comparison with other elements. The isobars, or lines of equal barometric pressure, are drawn for each tenth of an inch, and figures are given in the central areas of the several depressions to show the lowest reading of the barometer recorded by vessels passing through these disturbances. The direction and force of wind are shown by a system of arrows which fly with the wind, and the different forms of arrow exhibit very readily where the wind reaches the force of a gale, whilst the winds at high-level stations, where the elevation is 4000 feet or upwards, are indicated by red arrows. The air- and sea-temperatures are shown by different coloured isotherms, or lines of equal temperature, which are drawn for each 5° F. The weather, such as rain, fog, or mist, is shown by different methods of shading, and, as mentioned above, is given with each style of chart. The synchronous hour for which the observations are charted is noon Greenwich time, except in the case of air- and sea-temperature, where local noon has been taken in preference. No letterpress has been published with the charts except a few explanatory notes, in which it is stated that the study of the weather of Western Europe for many years has established in a manner that is beyond question that the atmospheric disturbances, on which the changes of weather are in a great measure, if not mainly, dependent, reach our western coasts after having passed for a longer or shorter distance over the Atlantic. The Meteorological Council undertook the investigation with a view to ascertaining as far as possible the conditions under which such disturbances either originate in or traverse the Atlantic, and the extent to which the direction of their course, their magnitude, and persistence, may be influenced by the general meteorological conditions of the area within which they are generated, or of the regions which surround that area.

The period embraced by the charts is that during which the international system of circumpolar observations was being carried out, and data have thus been obtained from very high northern latitudes, which could not otherwise have been procurable, and by these means the results embodied in the charts have not only been rendered far more complete, but are of an exceptional value, not likely to be soon equalled. Among the circumpolar observations regularly used for the charts are those made at Spitzbergen and Jan Mayen, two stations which add materially to the value of the information on the eastern side of the Atlantic, as they enable many very important barometric changes to be traced which would otherwise be lost, and they help much in fixing the position of disturbances which have skirted the British coasts, and at the time when our weather is improving as these bad-weather systems are passing away.

There are, on an average, observations from rather more than 400 ships for each day, in addition to which there are daily observations from about 300 land stations. In all 11,236 returns, each containing the records of many days, have been received from about 3000 vessels. So large a number of observations have never before been used in the drawing of synchronous charts, and this of itself renders the work quite unique in its character. The area embraced, which extends from the Pacific Coast of America to the east of Moscow, in the heart of Russia, and from the Arctic to the Equator, enables the numerous weather changes to be watched day by day for days together, and allows of a very extensive and comprehensive view of the influence of the several varying conditions of the weather.

The charts show many very interesting features of weather changes, and they exhibit very clearly the general way in which the weather systems move from west to east in the middle latitudes. They show very frequent tracks of low-pressure areas to the north of the parallel of 40°, such areas being frequently observed over the United States; and after traversing North America, they intensify and develop energy on reaching the Atlantic, apparently gaining much of their strength from the supply of vapour over the ocean. Many such storms can be traced across the Atlantic, while some die out